Technology Opportunity

MEMS Regenerative Fuel Cell for Portable Power

The Power and On-Board Propulsion Technology Division of NASA Glenn Research Center (GRC), with funding from the Glennan MicroSystems Initiative, is developing a miniature proton exchange membrane (PEM) fuel cell. A commercial partner is being sought to assist in the development and eventual packaging, production, and marketing of these miniature fuel cells.

Potential Commercial Uses

The tremendous potential for a water-based regenerative fuel cell is evident from the following applications:

- Cellular phones
- Portable electronics
- Computers
- Medical devices (e.g., hearing aids)
- Scientific instruments
- Microspacecraft

Benefits

- High packaged specific energy (>200 W-hr/kg)
- Environmentally friendly (uses only water, silicon and platinum)
- Lightweight (<14 g for AA size fuel cell)
- Long life

The Technology

Energy storage media are required to provide power to spacecraft during the dark part of the orbit. State-of-the-art battery technology is used, but batteries are generally heavy and have short lifetimes for long duty cycles, or they are large so as to reduce depth-of-discharge-related problems.

The desire to reduce spacecraft size to miniature proportions has driven the development of new microscale spacecraft subsystems. One of these developments is the water-based fuel cell, in which a bifunctional membrane electrode assembly (MEA) is used in a sealed cavity partially filled with water, hydrogen, and oxygen. To utilize current commercial infrastructure, the basic diameter was selected to correspond to a AA battery size, with a thickness between 2 and 3 mm. Silicon is used as structural material for the endplates, with silicon nitride and silicon oxide as insulators. A bifunctional MEA is embedded to electrolyze water for energy storage in the charge mode and to provide power in the discharge mode.

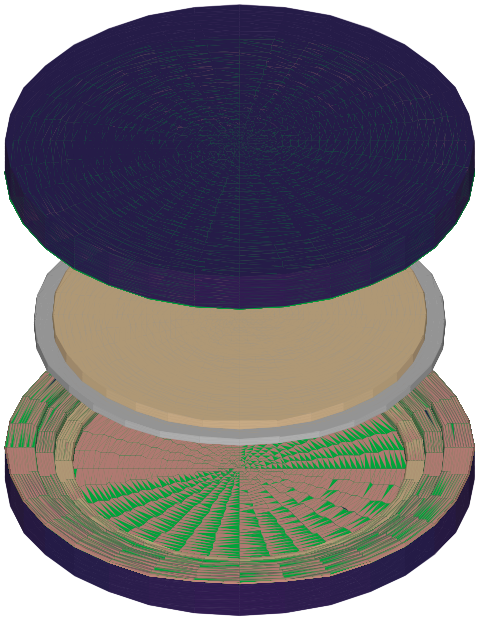

Figure 1.—MEMS URFC assembly.

In a recently initiated proposal for a partnership with Energizer, GRC will develop and test the microelectromechanical (MEMS) unitized regenerative fuel cell (URFC) and evaluate applications. Energizer has agreed to assist GRC with the evaluation of the MEMS URFC. Researchers at Case Western Reserve University have agreed to participate in the evaluation and development of alternate MEA concepts that could enhance performance and/or reduce cost.

Figure 1 shows the first prototype design to be tested in the fall of 1999. The endplates are designed to maximize the internal pressure, and stacking several units will provide additional support and optimize the capacity. The MEA is shown as a PEM membrane with bi-directional electrodes.

Options for Commercialization

The intellectual property status will be governed by the Glennan Microsystems Initiative guidelines, which describe the type of partnership arrangements available for this technology, the intellectual property status, types of partners sought, and other information of interest to potential business partners.

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